

KAILARSENIA TIRVENGADUM EMEND. PUTTOCK (RUBIACEAE: GARDENIEAE) IN AUSTRALIA

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Summary

Gardenia jardinei F. Muell. ex Benth., *G. ochreata* F. Muell. and *G. suffruticosa* R. Br. ex Benth. are revised and transferred to *Kailarsenia* Tirvengadum emend. Puttock. Full descriptions, notes and a key to these species are provided. *Gardenia kershawii* Bailey, *G. macgillivraei* Benth. and *G. ochreata* var. *parviflora* F. Muell. are analysed using multiple regression analysis. These taxa are reduced to synonymy of *Kailarsenia ochreata* (F. Muell.) Puttock.

Following the revision of *Gardenia* Ellis and *Randia* Houst. ex L. in West Africa (Keay 1958) there has been a piecemeal regional dismemberment of these two large heterogeneous assemblages. Unfortunately several of the resultant small genera have been poorly circumscribed (e.g. Tirvengadum & Sastre 1979; Tirvengadum 1983) and thus the assessment of relationships of some taxa outside local regions has been difficult. This paper considers four of the five taxa removed from *Gardenia* by Puttock (1988) viz *G. jardinei* F. Muell. ex Benth., *G. kershawii* Bailey, *G. macgillivraei* Benth. and *G. ochreata* F. Muell. It also accounts for the only other Australian species belonging to this group, *G. suffruticosa* R. Br. ex Benth., a Northern Territory endemic.

These species are similar to *Gardenia sens. strict.* in possessing sympodial branching, conical stipules and unilocular ovaries with many ovules. They differ, however, in producing monad pollen and polygamous flowers, and in having leaves with intersecondary venation (Hickey 1973). This combination of characters places them in *Rothmannia* Thunb. (*sensu* Bremekamp 1957 and Yamazaki 1970), or in *Kailarsenia* Tirvengadum.

Tirvengadum (1983) gave only a brief diagnosis of *Kailarsenia*, distinguishing it from *Rothmannia sens. strict.* on the basis of rheophytic habit, tubular 2-lobed persistent stipules, fasciculate flowers with linear lanceolate or tentaculate calyces, small fruits and testa cells thickened but without pits or ornaments. This diagnosis provides little accurate information concerning the type species *Kailarsenia tentaculata* (J.D. Hook.) Tirvengadum and the other five species placed in the genus. The evolution of the rheophytic habit is considered at best useful at the specific and subspecific level in the Gardenieae (Robbrecht 1988). *Rothmannia sens. strict.* has interpetiolar stipules that are short, triangular and free to the base. In *Kailarsenia tentaculata* the stipule is an elongated, chartaceous, conical sheath, terminating with two minute interpetiolar limbs. The expanding bud tears the sheath along two intrapetiolar lines of weakness to form two sheathing lobes that persist on the stem until the abscission of the leafbases. Inflorescences are clearly variable within genera of the Gardenieae and even within the six species currently attributed to *Kailarsenia*. The inflorescence is basically cymose but the axes may be reduced to give the appearance of "fasciculate flowers", as in *K. tentaculata*. Several species have been described with or as often having solitary flowers (e.g. *K. lineata* (Craib) Tirvengadum and *K. godefreyana* (O. Kuntze) Tirvengadum). Tirvengadum described the fruits of *Kailarsenia* as small. However, at least one species, *K. stenosepala* (Merr.) Tirvengadum, has fruits to 2.5 cm long, which is in the second largest fruit-size class (III) described for the Gardenieae, a class only exceeded in the Gardeniinae by some species of *Rothmannia* (Robbrecht & Puff 1986). The majority of the *Kailarsenia* species are within Robbrecht and Puff's intermediate (1–2 cm) fruit-size class (II). The exotestal cells are thickened along the radial and inner tangential walls in *K. tentaculata* with the thickening of the inner tangential walls distinctly pitted (= "perforations" of Robbrecht & Puff 1986, see fig. 20e4). In this species the exotestal cells around the hilum and the rest of the perimeter of the seed are markedly radially elongated compared with those on the flat surfaces (see Robbrecht & Puff 1986, fig. 17e–g). These features of the seed-coat appear to contradict Tirvengadum's description (without pits or ornaments).

Hooker (1880) described the flowers of his *Gardenia tentaculata* as polygamous, but according to Robbrecht and Puff (1986) and my own observations on limited herbarium material, they are hermaphrodite. The condition in the other five south-east Asian species has not been investigated.

The Australian species agree with the two characters that appear to be unique to *Kailarsenia*, the nature of the stipule and the seed-coat morphology. In all three Australian species the stipule is an elongated, chartaceous sheath with minute, terminal, interpetiolar limbs (figs 1h,q, 5g). The seed-coat in *Gardenia jardinei* and *G. ochreatea* is considerably well developed around the hilum. The inner tangential walls of the exotestal cells of *G. jardinei* have almost identical pitting to that found in *Kailarsenia tentaculata*, while the pits in *Gardenia ochreatea* are much larger giving a prominent reticulum. The Australian species also closely agree with other character states found within *Kailarsenia*: unarmed trees and dwarf shrubs, ovaries unilocular, fruits many seeded, seeds embedded in placental mass, pollen 3- or 4-colporate, colleters lanceolate, flowers solitary or in few-flowered cymes, calyces linear, corolla tubes tubiform, corolla lobes usually shorter than corolla tube, and anthers and style scarcely exerted beyond the throat of the corolla tube. In addition, all three Australian species show some degree of polygamy, a character described for *K. tentaculata* by Hooker (1880) but as yet unconfirmed in this or other south-east Asian species. Therefore, on the basis of the essential agreement of vegetative, floral and fruit characters, and in particular the stipular and seed-coat morphologies, the three Australian species are now transferred to *Kailarsenia*. It is necessary to emend *Kailarsenia* to include the diversity of the characters of the six original taxa and the Australian species. Hence, a new and full generic description is provided below.

All Australian species have been observed in the field. Descriptions and measurements are based on living and dried material and are applicable to both. The terminology used in this paper for bark, leaf venation and floral characters follows Puttock (1988). The conservation status has been coded using the ranks proposed by Leigh, Briggs and Hartley (1981).

Taxonomy

***Kailarsenia* Tirvengadam emend. Puttock. Type: *K. tentaculata* (J.D. Hook.) Tirvengadam**

Dioecious, gynodioecious, or ?monoecious, facultatively deciduous, thornless dwarf shrubs or small trees with sympodial branching. Bark layered, subrhynchidome deep green. Wood hard and close grained, not brittle, cream. Leaves opposite or ternate, often unequal, petiolate; lamina entire; secondary venation camptodromous with intersecondary veins and reticulate tertiary veins; domatia commonly present in secondary/midvein angles. Stipules connate, fused into a long sheath with 2 or 3 minute, terminal, interpetiolar limbs; sheath membranous or chartaceous, splitting with bud expansion to form larger lobes, usually persisting until leafbase abscission. Numerous lanceolate to cylindrical colleters present in the basal part between stipule and stem, producing a small quantity of viscid resin. Flowers in terminal, 2-8-flowered cymes, or solitary. Flowers hermaphrodite, or functionally male and female and dimorphic, 5- or 6(-8)-merous, pedicellate. Hypanthium globular, smooth, without ridges continuous with the calyx lobes. Calyx coriaceous; tube cylindrical or tubiform with linear, erect or reflexed lobes. Corolla pale green in bud, white at anthesis, turning yellow with age; tube cylindrical, tubiform or crateriform; lobes patent, narrowly ovate to elliptical, usually shorter than the tube. Anthers sessile, linear, more or less medifixed; tips of pollen-bearing anthers (male and hermaphrodite flowers) exceeding the tube by several millimetres, sterile anthers (female flowers) enclosed. Pollen grains single, radially symmetric, isopolar, 3- or 4-colporate, exine smooth. Style usually clavate; stigmata 2(-4), connate, sometimes with reflexed lobes, emarginate, exerted by several millimetres in flowers with sterile anthers, rarely exceeding the corolla tube in male flowers. Disc annular. Ovary unilocular with 2 or 3 parietal placentas; ovules numerous, partially embedded in the placenta. Fruit globular to ellipsoid drupe or berry, more than 10 mm diameter, usually crowned by persistent calyx; pericarp thin and parenchymatous with a membranous endocarp, or thick and fibrous with a bony putamen. Seeds numerous, lenticular, embedded in the firm placental pulp. Seed-coat thicker around the hilum, which occupies one-third to one-half of the perimeter of the seed; exotestal cells with radial and inner tangential walls sclerified; thickening of inner tangential wall pitted or forming a reticulum.

A genus of about eleven species; three endemic to tropical Australia; about eight species in tropical Asia, but none known from New Guinea.

Key to the Australian species of *Kailarsenia*

1. Dwarf shrubs with underground stems (geofrutex); leaves lanceolate or, if obovate, less than 3 cm long; mesocarp parenchymatous, endocarp membranous (NT) ***K. suffruticosa***
 Small trees; leaves elliptical to obovate, more than 5 cm long; mesocarp fibrous; endocarp brittle (NEQ) 2
2. Leaves glabrous, 5–12 cm long, 3–7 cm wide, drying black, secondary veins 8–12 each side of the midvein; petioles 1–4 mm long; stipules 5–8 mm long ***K. jardinei***
 Leaves tomentose to sub-glabrous, 5–25 cm long, 3–13 cm wide, drying various shades of brown, secondary veins 12–18 each side of the midvein; petioles 3–12 mm long, stipules 8–11 mm long ***K. ochreatea***

Kailarsenia jardinei (F. Muell. ex Benth.) Puttock, **comb. nov.**

Gardenia jardinei F. Muell. ex Benth., Fl. austral. 3: 410 (1867). **Type:** Queensland. NORTH KENNEDY DISTRICT: Mt Elliot, undated, *Dallachy* s.n., (lecto (here chosen): K!; isolecto: MEL!(MEL 598350)).
 F. Mueller, Fragm. 7: 46 (1869); F.M. Bailey, Syn. Queensl. fl. 222 (1883).

Diocious, columnar tree to 15 m tall; trunk at breast height to 27 cm diameter. Bark to 25 mm thick, with shallow irregular tessellations, grey; outer bark layered and with brownish orange blaze; inner bark blaze fawn to cream; bark of branches silver-grey or green, glabrous; lenticels irregular to circular protrusions; young internodes occasionally with minute hyaline hairs. Leaves ternate or rarely opposite; petioles 1–4 mm long, glabrous or minutely hairy, greyish green; lamina ovate to elliptical with obtuse apex and base, 5–12 cm long, 3–7 cm wide, glabrous, glossy deep green above, dull deep green below, thinly coriaceous; secondary veins 8–12 pairs, at 45–55° to the midvein, raised above and below; tertiary venation translucent; well-formed shallow depressions in secondary/midvein angles with woolly tuft of long hyaline hairs. Stipules 8–10 mm long, minutely hairy or glabrous outside; colleters cylindrical, 0.3–0.45 mm long, 0.15–0.2 mm wide. Female or hermaphrodite flowers unknown; male flowers 5- or 6-merous, solitary or in 2–4-flowered cymes. Pedicels 3–5 mm long, glabrous. Hypanthium 5 mm long, glabrous. Calyx glabrous; tube tubiform, 2–3 mm long; lobes linear, 3–5 mm long, reflexed or rarely erect. Corolla tube cylindrical, 20–40 mm long, 2–3 mm diameter at the base increasing to 4 mm diameter in the upper part, glabrous; lobes elliptical to narrowly ovate, 15–30 mm long, 5–10 mm wide, glabrous. Pollen-bearing anthers 8–10 mm long, attached 5–7 mm from their apices, inserted 3–4 mm below the sinuses of the corolla lobes, their apices exceeding the tube by 2–3 mm. Style 8–10 mm long, not reaching the anthers, glabrous; stigmatic lobes 2(3), 2–3 mm long, reflexed. Placentas 2 or 3, bearing 60–70 ovules each. Fruit usually solitary, ellipsoid, 25–40 mm long, 20–40 mm diameter, smooth, crowned by persistent calyx remnants; pedicels 2–4 mm long; exocarp pale green whilst developing, yellowish green when mature; mesocarp fibrous, 3–5 mm thick; endocarp brittle, 0.5–1.0 mm thick; placental mass cream. Seeds 3.2–4.9 mm diameter, 0.9–1.8 mm thick; hilum occupying 0.37–0.43 of perimeter of seed; seed-coat pale brown; exotestal cells with pitted thickening of inner tangential walls. **Fig. 1 A–I.**

Selected specimens: Queensland. NORTH KENNEDY DISTRICT: Mt Elliot, undated, *Dallachy* s.n. (K,MEL); Mt Elliot, [1858], *Fitzalan* s.n. (MEL (MEL 103682, MEL 103683)); 1.5 km E of Splitters Ck, NE of Mt Roundback, 19°59'S, 148°00'E, Jan 1983, *Puttock* UNSW 14494 (K,UNSW); Port Denison, undated, *Dallachy* s.n. (MEL (MEL 578349)); Mt Dryander, undated, *Fitzalan* s.n. (MEL (MEL 103681)); Cannonvale, Nov 1959, *Jones* 1347 (BRI,CANB); between Airlie Beach and Shute Harbour, 20°16'S, 148°46'E, Nov 1983, *Puttock* UNSW 15822 (UNSW); between Shute Harbour and Airlie Beach, 20°17'S, 148°46'E, Jan 1983, *Puttock* UNSW 14260 (BISH,BR,K,MEL,UNSW). SOUTH KENNEDY DISTRICT: scrubs nr Mackay, Jan 1926, *Langfudy* [14] (BRI). (23 specimens examined).

Distribution and habitat: Endemic to the coastal slopes and plains between Mount Elliot (19°30'S) and Mackay (21°10'S) from sea level to 100 metres altitude but recent collections only known from Mt Roundback near Bowen, and Conway National Park and neigh-

bouring islands (**Map 1**). It is found in the open woodland and deciduous vine thickets behind mangroves on shale and alluvial soils in the Conway National Park.

Phenology and pollination biology: Flowering from November to February, flowers sweetly perfumed; fruits maturing between March and August. Many small scarab beetles visit flowers, but no lepidoptera have been observed (pers. obs. Conway NP).

Affinities: Closely related to *K. ochreatea*, from which it differs by its glabrous, glossy leaves with shorter petioles and fewer secondary veins and shorter stipules, as well as its essentially glabrous fruits.

Conservation status: This species is locally common near Strathdickie, and between Airlie Beach and Shute Harbour. Much of its original habitat in this area is now given over to sugarcane, and other pockets of natural vegetation are under threat of urban development. However, small populations will survive in the refuges of Conway National Park and on the lower slopes of Mount Dryander. Near Bowen (formerly Port Denison) it can be found sporadically along the banks of creeks draining Mount Roundback. Much of this area is improved pasture, and very few trees remain even along the gullies. Conservation status 2K.

Vernacular name: None known.

Etymology: The isoelectotype sheet at MEL which was annotated by Mueller states that the species was named after Mr [F.L.] Jardine, the Police Magistrate at Albany Bay, Cape York.

Typification and notes: The only sheet of the specimens cited in the protologue and known to have been seen by Bentham (Mount Elliot, *Dallachy*) is here chosen as the lectotype. Protologue specimens from both localities are lodged at MEL.

Although Bentham (1867) described the fruit as having three parietal placentas, this is extremely rare; commonly there are two. As in the other two Australian species, floral dimorphism probably occurs, but only pollen-producing flowers are known despite extensive searching in January and November 1983.

Kailarsenia ochreatea (F. Muell.) Puttock **comb. nov.**

Gardenia ochreatea F. Muell., *Fragm.* 1: 55 (1858). **Type:** Queensland. NORTH KENNEDY DISTRICT: In less fertile grassy places along the Burdekin River, [October 1856], *Mueller* s.n., (lecto (here designated): K!(lower right hand element); isoelecto: MEL!(MEL 598352)).

Essay on the plants collected by Eugene Fitzalan during Lieut. Smith's Expedition to the Estuary of the Burdekin 11 (1860); G. Bentham, *Fl. austral.* 3: 409 (1867); F.M. Bailey, *Syn. Queensl. fl.* 222 (1883), *Queensl. fl.* 3: 756 (1900), *Compreh. catal.* 241, pl. 215 (1913); K. Domin, *Biblioth. Bot.* 22(89): 620, pl. 193 (1929); B.P.M. Hyland, *Common Rainforest Trees* 2nd ed. 95 (1981).

Gardenia ochreatea var. *parviflora* F. Muell., *Fragm.* 7: 46 (1869). **Type:** Queensland. LEICHHARDT DISTRICT: Issacs R., [1844], *Leichhardt* 34 (holo: MEL!).

Gardenia macgillivraei Benth., *Fl. austral.* 3: 409 (1867). **Type:** Queensland. COOK DISTRICT: Cape York, November 1849, *MacGillivray* s.n. (Bot. 509), (lecto (here designated): K(upper element on sheet of flowering material)!). F. Mueller, *Fragm.* 7: 46 (1869); F.M. Bailey, *Syn. Queensl. fl.* 222 (1883), *Queensl. fl.* 3: 756 (1900).

Gardenia kershawii Bailey, *Queensl. Agric. J.*, n.s. 2: 75, pl. 37 (1914). **Type:** Queensland. COOK DISTRICT: Claudie River, undated, *Kershaw* (lecto (here designated): BRI!).

Dioecious or ?gynodioecious, columnar tree to 10(–20) m tall; trunk at breast height to 15 cm diameter. Bark to 15 mm thick, smooth, flaky or shallowly tessellated, silver to dark grey; outer bark layered, granular with a pinkish brown blaze; inner bark blaze cream; branches silver-grey to rusty brown, glabrous to tomentose; lenticels scattered, tangentially-elongated to circular protrusions. Leaves ternate or occasionally opposite, tomentose to glabrous; petioles 3–12 mm long, greyish green; lamina obovate to elliptical with an acute apex and an obtuse or decurrent base, 5–25 cm long, 3–13 cm wide, pale

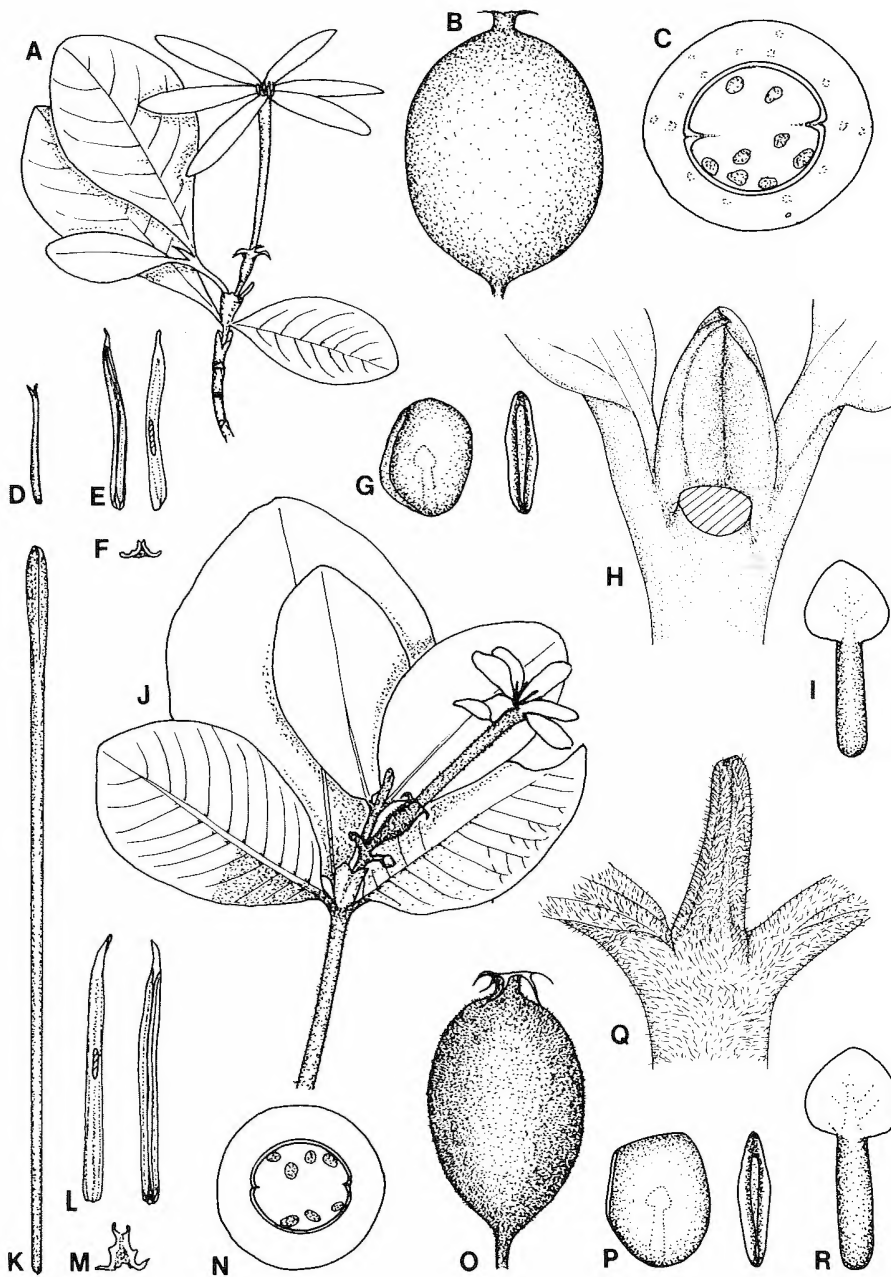


Fig. 1. *Kailarsenia jardinei*: A. flowering branchlet $\times 0.67$. B. mature fruit $\times 1$. C. T.S. of mature fruit $\times 1$. D. style $\times 3$. E. anther, 2 views $\times 3$. F. T.S. of polleniferous anther $\times 6$. G. seed, 2 views $\times 3$. H. stipule crowning branch tip $\times 5$. I. embryo $\times 10$. *K. ochreata*: J. flowering branchlets $\times 0.67$. K. style $\times 3$. L. anther, 2 views $\times 3$. M. T.S. of polleniferous anther $\times 6$. N. T.S. of mature fruit $\times 1$. O. Mature fruit $\times 1$. P. seed, 2 views $\times 3$. Q. stipule crowning branch tip $\times 5$. R. embryo $\times 10$. (A, Puttock UNSW14260; D-F, Puttock UNSW15822; B,C,G,I, Puttock UNSW15809; H, Puttock UNSW14494; J, Wyatt s.n.; K-M, Clarkson 5032; N,O,P,R, Puttock UNSW13326 & Wilson; Q, Puttock UNSW15833).

green above, dull pale green below, chartaceous to thinly coriaceous; secondary veins 12–18 pairs, at 45–60° to the midvein, not raised above, raised below; tertiary venation translucent; shallow depressions in secondary/midvein angles with a dense tuft of long hyaline hairs. Stipules 5–12 mm long, tomentose to subglabrous; colleters lanceolate, 0.3–0.5 mm long, 0.12–0.17 mm wide, accompanied by hyaline hairs. Flowers (5)6-merous, solitary or occasionally in 2–4-flowered cymes; pedicels 6–12 mm long, tomentose or glabrous. Hypanthium 5–12 mm long, tomentose to glabrous. Calyx tube tubiform, 5–8 mm long; lobes linear, 6–12 mm long, reflexed or erect, tomentose to glabrous. Corolla tube cylindrical, 20–55 mm long, 2–3 mm diameter at the base increasing to 4–5 mm diameter in the upper part, glabrous or sparsely pubescent outside, hairy to subglabrous inside; lobes narrowly elliptical, 17–40 mm long, 6–13 mm wide, glabrous. Pollen-bearing anthers 12–14 mm long, attached 5–7 mm from their apices, inserted 2–3 mm below the sinuses of the lobes, exceeding the tube by 3–6 mm. Sterile anthers 6–8 mm long, attached 2–3 mm from their apices, included within the corolla tube. Style 18–58 mm long, hairy to glabrous, exceeding the corolla tube by 3–6 mm in plants with sterile anthers, but reaching only to the middle of the anthers in pollen-producing flowers; stigmatic lobes (2)3(4), 6–14 mm long, connate. Placentas (2)3(4). Fruit usually solitary, ovoid, 22–50 mm long, 15–35 mm diameter, smooth, glabrous or sparsely hairy; pedicels 6–12 mm long; calyx persistent as a collar or reflexed ring bearing remnants of the lobes; exocarp pale green whilst developing, yellowish green when mature, 4–6 mm thick; mesocarp fibrous, 3–5 mm thick; endocarp brittle or hard, 0.5–2.5 mm thick, yellow; placental mass cream. Seeds 3.1–6.2 mm diameter, 1–1.3 mm thick; hilum occupying 0.34–0.45 of perimeter of seed; seed-coat pale brown; exotestal cells with reticulate thickening of inner tangential walls. **Fig. 1 J–R.**

Selected specimens: **Queensland.** COOK DISTRICT: Cape York (between carpark and beach), 10°41'S, 142°31'E, Jul 1984, *Puttock* UNSW 16933 & *King* (BRI,CANB,UNSW); Cape York, Nov 1849, *MacGillivray* s.n. [Bot. 509] (K); Cape York, undated, *Hill* 131 (K); South Kokialah Ck, c. 40 km E of Aurakun, 13°20'S, 142°32'E, May 1982, *Clarkson* 4392 (K,NSW,QRS); Claudie R., undated, *Kershaw* (BRI); Melville Ra., 14°15'S, 144°30'E, Sep 1970, *Hyland* 4817 (BRI,QRS); Kimba–Palmerville rd, 15°35'S, 144°03'E, Nov 1983, *Clarkson* 5032 (BRI,UNSW); Trevethan Ra. nr Black Gap, Cooktown Dev. rd, 15°39'S, 145°13'E, Dec 1983, *Puttock* UNSW 15929 (BRI,CANB,NSW,UNSW); slopes of Mt Surprise, Dec 1983, *Puttock* UNSW 15833 (CANB,NSW,UNSW). **NORTH KENNEDY DISTRICT:** In less fertile grassy places along the Burdekin River, [1856], *Mueller* s.n. (K,MEL); Magnetic I., 19°10'S, 146°50'E, Apr 1970, *Wyatt* s.n. (BRI); Alligator Ck, 19°27'S, 146°57'E, Jun 1982, *Puttock* UNSW 13326 & *Wilson* (BRI,CANB,UNSW); Burdekin Expedition, [Cape Upstart, 1859, *Fitzalan*] 11 (MEL). **SOUTH KENNEDY DISTRICT:** Burdekin crossing, nr “Glendon”, 20°39'S, 147°10'E, Sep 1950, *Smith* 4626 (BRI); c. 10 km from Mt Coolon towards Collinsville, Nov 1978, *Stanley* 78377 & *Ross* (BRI). **LEICHHARDT DISTRICT:** Isaacs R., [1844], *Leichhardt* 34 (MEL); SW end of Lake Elphinstone, 21°33'S, 148°14'E, Jan 1983, *Puttock* UNSW 14241 (BISH,BR,BRI,DNA,K,L,UNSW); “Tay Glen” nr Cotherstone, E of Clermont, Sep 1959, *Thomson* s.n. (BRI). (128 specimens examined).

Distribution and habitat: The species occurs in Queensland from the tip of Cape York (latitude 10°42'S) to Clermont (latitude 22°40'S); **Map 1.** In the northern part of Cape York it is commonly found in semi-evergreen mesophyll vine forests on alluvial soil with 1300–1600 mm annual rainfall. In the southern part of its range it is restricted to semideciduous vine forests, deciduous vine thickets and occasionally open woodland, growing almost exclusively in association with granite outcrops or on soils derived from granite with less than 1000 mm annual rainfall.

Phenology and pollination biology: Flowers are present from October to February (occasionally aseasonally), sweetly perfumed, visited (?pollinated) by papilionoid lepidoptera in the late afternoon (pers. obs. Cape York); fruits mature between March and August and ripen on the ground. Reported to be eaten by aborigines (*Mueller* 1860).

Vernacular names: Scented Gardenia bush, wild Gardenia (*Williams* 1979).

Etymology: *Ochreatea* (from *ocreatus*, greaved, i.e. fitted with armour for the ankles and shins) refers to the sheathing nature of the oblong stipules (*Mueller* 1858).

Typification and notes: *Mueller's* type collection of *Gardenia ochreatea* was made during the latter stages of the Gregory Expedition (October 1856), from one of numerous pockets of semideciduous vine forest along the Burdekin valley between “Jervoise” and the confluence of the Burdekin and Sutor Rivers. The best of the type material is at K: of the four elements on the single sheet there, the flower-bearing element in the lower right is designated lectotype. Although the fruit was described in the protologue, none are with the type material. Authentic type material is labelled “Burdekin”, not to be confused with other collections labelled “Burdekin Expedition” collected by *Fitzalan* at Cape Upstart in 1859.

Mueller (1869) described *G. ochreata* var. *parviflora* for a collection made by Leichhardt from Isaac River. Only one specimen is known and this is regarded as the holotype. Mueller distinguished this variety by the corolla lobes being "only 1/2" long" and "equalling the tube"; the corolla tube of var. *ochreata* being "up to 2" long".

Gardenia kershawii Bailey was described from a collection of mixed material (see Puttock 1988). The lectotype is conspecific with *Kailarsenia ochreata*.

Gardenia ochreata var. *parviflora* and *G. kershawii* have only ever been applied to their type specimens.

Gardenia macgillivraei Benth. was described from two collections from the vicinity of "Somerset" at the top of Cape York Peninsula. The upper element on MacGillivray's sheet of flowering material at K is chosen as the lectotype. Bentham (1867) did not describe the anthers. Mueller (1869) added the description of the anthers from an unspecified collection.

G. macgillivraei has been separated from *G. ochreata* on the basis of leaf shape, size, venation and tomentum, bark type, flower and fruit size, and distribution. The northern material is also highly variable in endocarp thickness. To investigate the limits between these populations, additional collections were made in the region between northern Cape York and the South Kennedy District (11°S and 16°S). From north to south trees become smaller, leaves become smaller with fewer veins and more densely hairy or tomentose, flowers and fruits become smaller, bark becomes tessellated, and the habitat becomes restricted to granite soils and outcrops, and to regions of lower rainfall. The trend in the leaf size and hairiness is illustrated in Figure 2 using specimens collected at approximately one degree intervals of latitude.

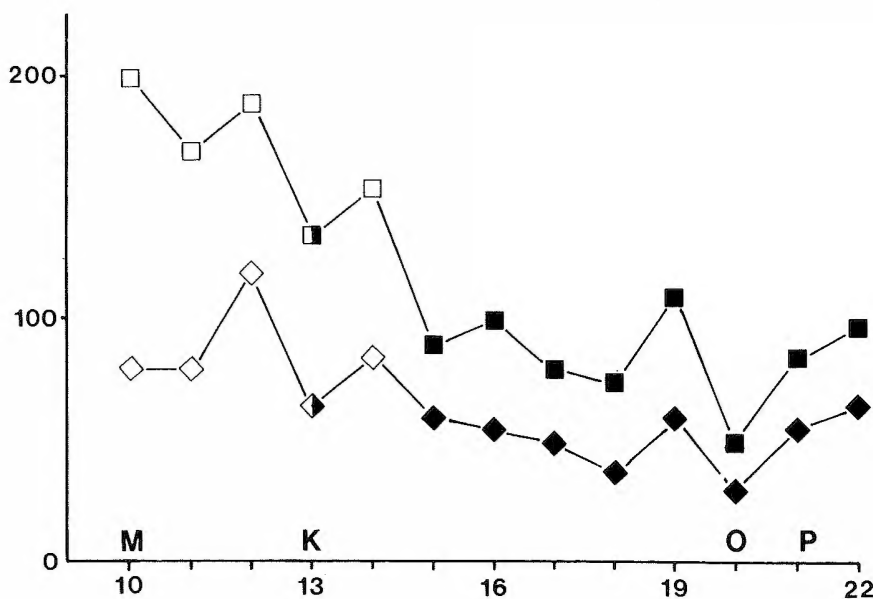


Fig. 2. Raw values of lamina length (□) and width (◇) for herbarium specimens of *Kailarsenia ochreata* collected closest to 40°S of each degree of latitude within its range. Open symbols = ± glabrous; half closed symbols = scattered hairs; closed symbols = tomentose. M, K, O, & P indicate vicinity of type localities (see Map 1).

To test the hypothesis that there is continuous and gradual variation between the two extreme forms, all available specimens with mature fruit (47) were scored for 8 characters:

1. number of veins each side of the midrib;
2. pubescence on the abaxial surface: dense, scattered, glabrous;
3. petiole length;
4. lamina length;
5. lamina width;
6. pedicel length;
7. fruit length;
8. fruit width.

The data obtained were normalised and standardised and then subjected to a multiple regression analysis. The transformed data were reduced to a single value (Y) for each specimen. The scattergram of the Y values plotted against latitude falls within a narrow band with gradually increasing Y values to the south with no discernible disjunctions (Fig. 3). The multiple regression was highly significant ($P > > 0.001$). A similar analysis was performed on the 22 flowering specimens available, replacing corolla tube and lobe lengths for characters 7 and 8. Again, this revealed no clear discontinuity that would indicate existence of separate gene pools (Fig. 4), ($P \sim 0.001$). It is concluded, therefore that the specimens represent a single gene pool in which there is clinal variation in several characters that correlates with latitude. Hence *Gardenia macgillivraei*, *G. kershawii* and *G. ochreatea* var. *parviflora* are reduced to synonymy with *Kailarsenia ochreatea* and without subspecific ranks. The separate specific status previously accorded the northern and southern populations is an artifact of the marked differences between the extreme forms of the cline and lack of collections in intervening regions.

The floral dimorphism in this species is uniform throughout its distribution. Plants bearing flowers with sterile anthers and long styles have been observed to produce mature fruits. The ovaries of flowers with pollen producing anthers and short styles are well developed, having numerous ovules, but it has not been established whether they ever develop fruits and fertile seeds.

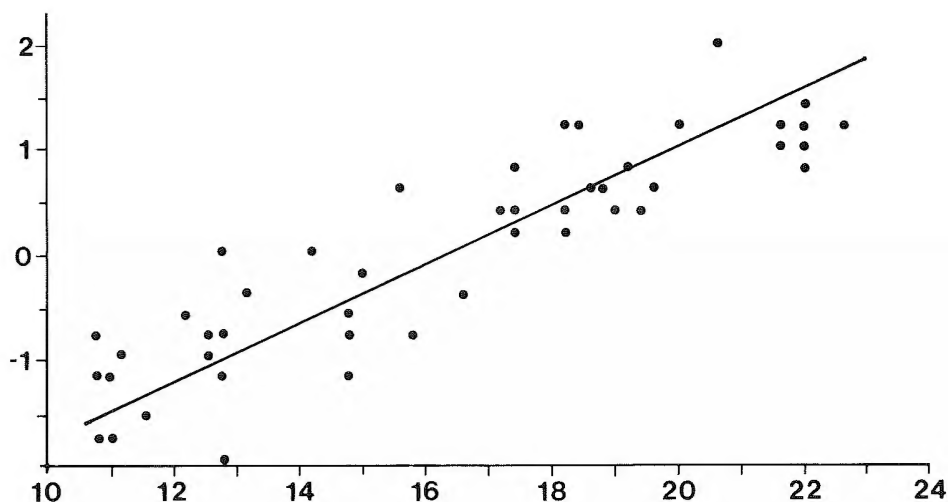


Fig 3. Scattergram of values obtained from multiple regression analysis of individual fruit-bearing trees of *Kailarsenia ochreatea* plotted against latitude. For characters scored see text. Y is the standardized form (with mean = 0 and standard deviation = 1) of the multiple regression estimate of latitude based on robust transformations of the observations.

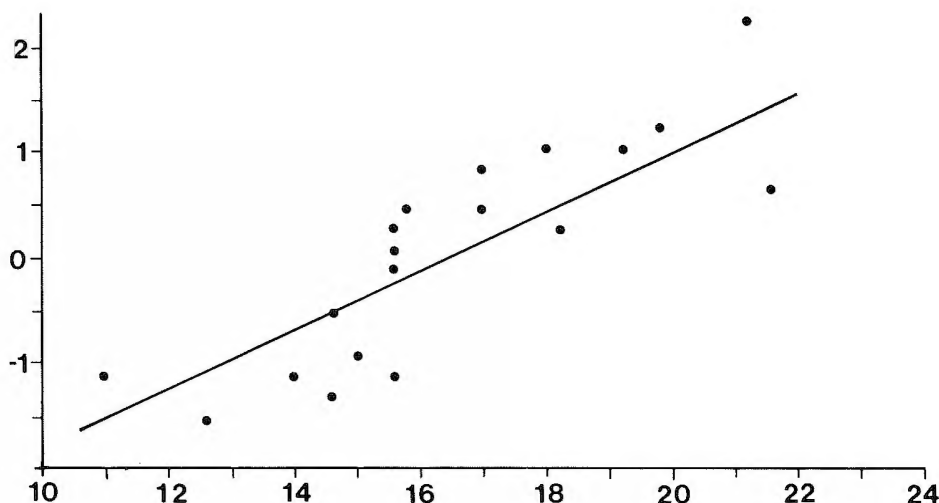


Fig. 4. Scattergram of values obtained from multiple regression analysis of individual flowering trees of *Kailarsenia ochreata* plotted against latitude. For characters see text. Y is the standardized form (with mean = 0 and standard deviation = 1) of the multiple regression estimate of latitude based on robust transformations of the observations.

***Kailarsenia suffruticosa* (R. Br. ex Benth.) Puttock comb. nov.**

Gardenia suffruticosa R. Br. ex Benth., Fl. austral. 3: 410 (1867). **Type:** Northern Territory. DARWIN AND GULF: Point S, Gulf of Carpentaria, 28 January 1803, Brown [3455], (lecto (here designated): BM!(fruiting element on left of sheet); isolecto: K!, two sheets). F.M. Bailey, Syn. Queensl. fl. 221 (1883); F.M. Bailey, Catal. pl. Queensland 22 (1890), Queensl. fl. 3: 756 (1900); Specht, Rec. Amer. Austral. exped. Arnhem Land 306 (1958).

Gynodioecious or ?dioecious, dwarf shrub (geofrutex) to 0.3 m high. Underground branches 10–20 mm diameter; aerial branches to 10 mm diameter; bark smooth, fawn; outer bark layered, granular, with a pinkish brown blaze; inner bark with cream blaze; branchlets pubescent; lenticels absent; subrhynchium deep green. Leaves opposite or ternate; petioles 1–3 mm long, greyish green; lamina lanceolate to oblong-obovate with an acute apex and an obtuse or decurrent base, 8–12 cm long, 1.5–2 cm wide, pale green above, dull pale green below, chartaceous, bullate and pubescent, or flat with scattered hairs below; secondary veins 6–13 pairs, at 40–50° to the midvein, sunken above, strongly raised below; tertiary venation translucent; shallow depressions in secondary/midvein angles on the abaxial surface with or without hyaline hairs. Stipules 5–8 mm long, pubescent outside; colleters lanceolate, 0.25–0.35 mm long, 0.12–0.15 mm wide, accompanied by hyaline hairs. Flowers 6(7)-merous, solitary or in 2–4-flowered cymes; pedicels 6–15 mm long, tomentose. Hypanthium 5 mm long, pubescent. Calyx tube cylindrical, 3–5 mm long; lobes linear, 5–10 mm long, erect, tomentose. Corolla tube cylindrical to tubiform, 18–25 mm long, 3–4 mm diameter at the base increasing to 7–8 mm diameter in the upper part, pubescent outside, tomentose on the upper part inside, glabrous below; lobes narrowly elliptical, 20–23 mm long, 10–13 mm broad, glabrous. Pollen-bearing anthers 9–11 mm long, attached 5–7 mm from their apices, inserted 4–5 mm below the sinuses of the corolla lobes, the tips exceeding the tube by 1–3 mm; sterile anthers 7–9 mm long, otherwise identical to pollen-bearing anthers. Style 20–28 mm long, exceeding the corolla tube by 2–6 mm, glabrous; stigmatic lobes 2(3), 9–14 mm long, connate. Placentas 2(3). Fruit solitary (only immature known) ovoid, 20–25 mm long, 12–15 mm diameter, smooth with scattered hairs; calyx persisting as a collar or reflexed ring bearing remnants of the lobes; pedicels 10–18 mm long; pericarp (not fully mature) succulent, about 2 mm thick; endocarp membranous. Mature seeds unknown. **Fig. 5.**

Selected specimens: Northern Territory. DARWIN AND GULF DISTRICT: Pickataramoor, Melville I., 11°45'S, 130°53'E, Dec 1977, *Angeles* s.n. (DNA); Gunn Pt area, 12°13'S, 131°03'E, Nov 1978, *Rankin* 1562 (CANB,DNA,MEL,PERTH); 6.1 km S of Old Point Stuart ruins, 12°21'S, 131°49'E, Nov 1980, *Waterhouse* UNSW 9857 (CANB,UNSW); 3.9 km E of Hades Flat, SE of Jabiluka Outlier, 12°40'S, 132°53'E, Dec 1980, *Waterhouse* UNSW 10923 (BR,K,UNSW); 12°05'S, 133°41'E, Jun 1974, *Pullen* 9484 (CANB); Point S, [Port Blane, Groote Eylandt,] Gulf of Carpentaria, Jan 1803, *Brown* 3455 (BM,K); Emerald R. rd, Groote Eylandt, 14°01'S 136°27'E, Feb 1977, *Waddy* 635 (DNA); Hemple Bay, Groote Eylandt, May 1948, *Specht* 342 (BRI,CANB,MEL,NSW); Yirrkala, 12°12'S, 136°47'E, Aug 1948, *Specht* 896 (CANB). (16 specimens examined).

Distribution and habitat: Endemic to the coastal plains and islands of the Darwin and Gulf District of the Northern Territory (**Map 1**). Of sporadic occurrence in open woodland on well drained sandy flats.

Phenology: Flowering mostly from October to February, but occasionally aseasonal, flowers sweetly perfumed; fruiting early in the dry season (from March).

Affinities: *K. suffruticosa* resembles *K. ochreatea* and *K. jardinei* in its ocreate stipules and corolla morphology, but differs from both in its lanceolate-oblong leaves, broader corolla tube, suffruticose habit, parenchymatous mesocarp and membranous putamen. In fruit characters and habit, *K. suffruticosa* has a closer affinity to the type species, *K. tentaculata*, from Malaysia.

Conservation status: This species is rarely collected, being generally obscured by tall grass for much of the year. It regenerates well after fire. It is probably under threat from grazing in some areas but may be well represented in Kakadu National Park (conservation status 3K).

Vernacular name: None known.

Etymology: Named for its low spreading habit.

Typification and notes: Of the three sheets of type material available, only that at BM has a precise location and date of collection; the fruiting element on the left of the BM sheet is designated lectotype.

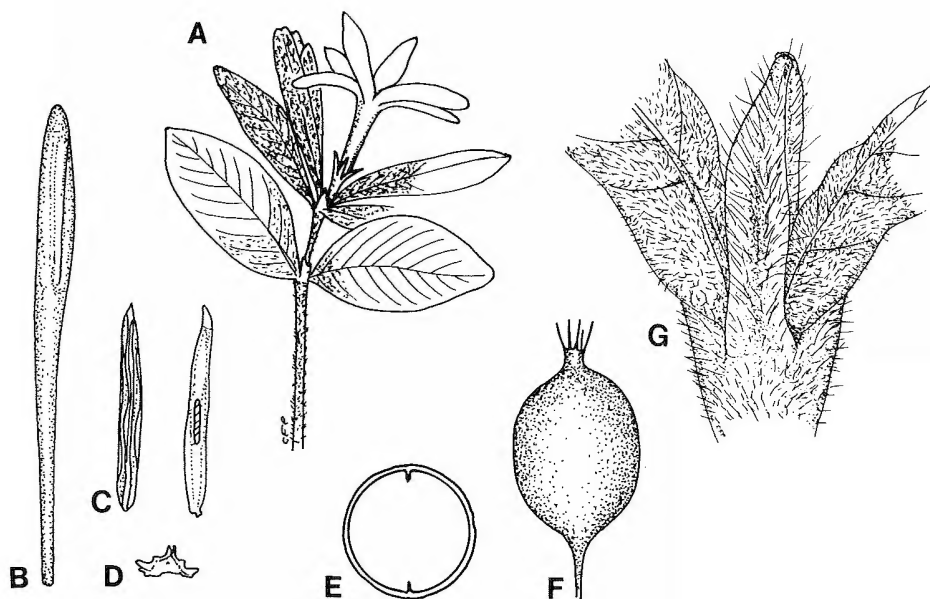
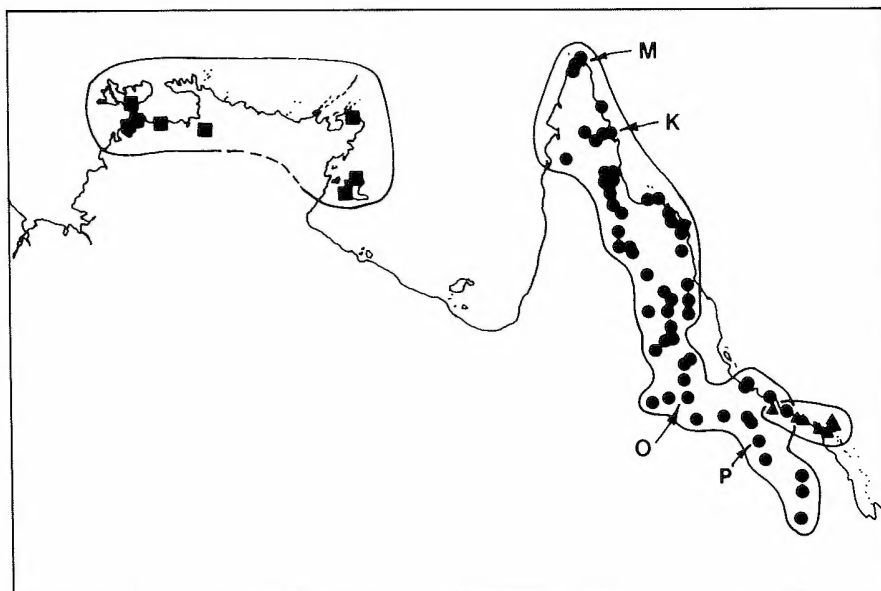


Fig. 5. *Kailarsenia suffruticosa*: A. flowering branchlets $\times 0.67$. B. style $\times 3$. C. anther, 2 views $\times 3$. D. T.S. of polleniferous anther $\times 6$. E. fruit (not completely mature) $\times 1$. F. T.S. of fruit $\times 1$. G. Stipule crowning branch tip $\times 5$. (A, *Waterhouse* UNSW9857; B–D,G, *Waterhouse* UNSW10923; E,F, *Waddy* 635).

This species requires further collecting to determine the significance of two leaf forms present in the material. Around Darwin to the west of Arnhemland and on Groote Eylandt the leaves are flat and bear scattered hairs on the veins; near the Arnhemland escarpment the leaves are bullate and densely pubescent.

Few flowering collections exist in herbaria and detail of the floral dimorphism is incompletely known. Some specimens have short, sterile anthers and long styles which appear to be receptive (females). Other specimens have longer anthers producing pollen, although, as in *K. ochreata*, the ovaries are scarcely smaller than in flowers with sterile anthers. However, unlike *K. ochreata*, the style is usually as long as, or longer than the corolla tube, and several pollen producing plants have been found with young fruits. Hence these flowers appear to be hermaphrodite.



Map 1. Distribution of *Kailarsenia* species in northern Australia. ▲ *K. jardinei*, ● *K. ochreata*, ■ *K. suffruticosa*. O, P, M, & K indicate the localities of the type specimens of *Gardenia ochreata*, *G. ochreata* var. *parviflora*, *G. macgillivraei* and *G. kershawii* respectively.

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